



Better Buildings Residential Network Peer Exchange Call Series: *Innovation Station: The Latest Advances in Energy Efficiency Technology*

May 18, 2017

Call Slides and Discussion Summary

Agenda

- Agenda Review and Ground Rules
- Opening Polls
- Brief Residential Network Overview and Upcoming Call Schedule
- Featured Speakers
 - **Ronnen Levinson**, staff scientist and leader of Heat Island Group, Lawrence Berkeley National Laboratory
 - **Chuck Booten**, senior engineer, Residential Building Systems, National Renewable Energy Laboratory (NREL)
 - **Jamie Howland**, director of the Climate and Energy Analysis Center, Acadia Center
- Discussion
 - Is your program currently considering using new energy efficiency technologies? What kind of technologies are of interest or would be helpful for your program?
 - What opportunities are there for integrating new technologies into program offerings?
 - Are there challenges to deploying new technologies in your programs, and how can they be addressed?
 - Other questions/issues/lessons learned related to new technology innovations?
- Closing Poll

Better Buildings Residential Network

Better Buildings Residential Network: Connects energy efficiency programs and partners to share best practices and learn from one another to increase the number of homes that are energy efficient.

Membership: Open to organizations committed to accelerating the pace of home energy upgrades.

Benefits:

- Peer Exchange Calls 4x/month
- Tools, templates, & resources
- Recognition in media, materials
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- Residential Program Solution Center guided tours

Commitment: Provide DOE with annual number of residential upgrades, and information about associated benefits.

For more information or to join, email bbresidentialnetwork@ee.doe.gov, or go to energy.gov/eere/bbrn and click Join

Best Practices: National Renewable Energy Laboratory (NREL)



EcoSnap-AC: The first window AC without the window

Chuck Booten and Jon Winkler, Co-inventors

The Problem with Window Air Conditioners

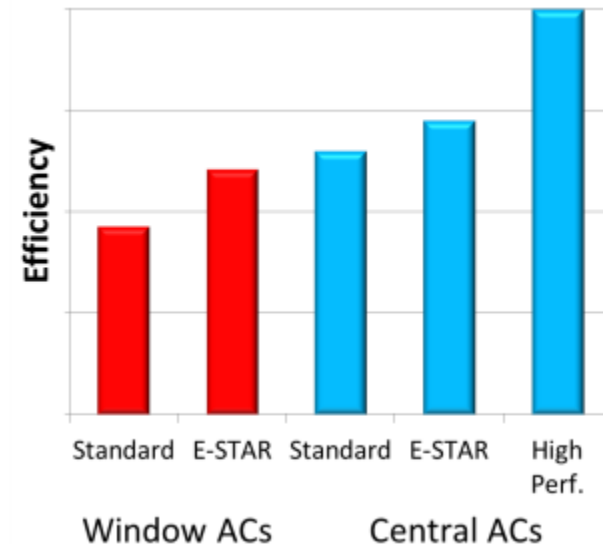
They're ugly!



They block the window!



They're inefficient!



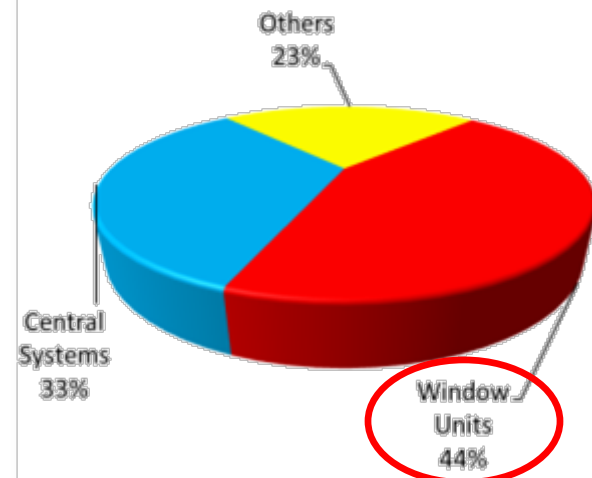
They're installed incorrectly!



They reduce security!



Yet dominate unit sales!!



The Problem with Portable Air Conditioners

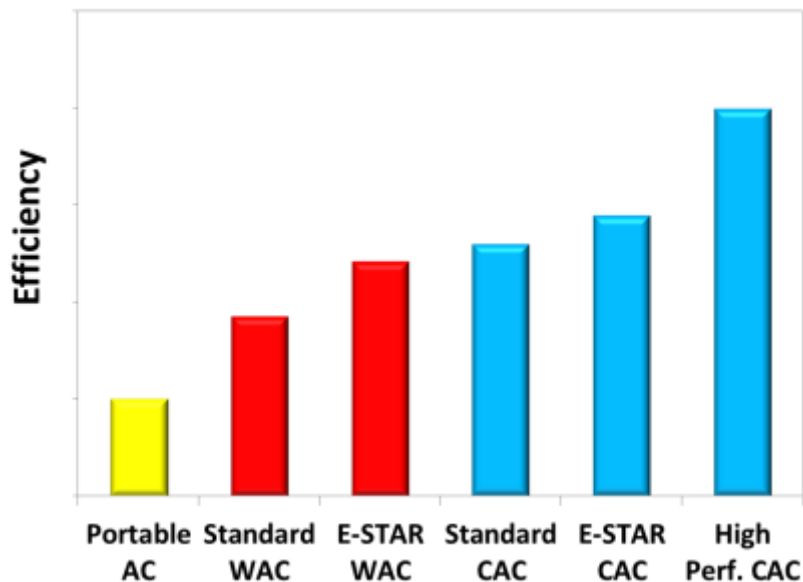
Take up space!



Have to deal with condensate!



Lowest efficiency!



More expensive than window air conditioners!



The Problem with Mini-Split Heat Pumps

10x more expensive than window air conditioners!



Install requires you to be home for an entire day!



Pounds of high global warm
erant!



Theft-prone line sets!



The Solution: EcoSnap-AC

Enjoy your windows while keeping your house comfortable and quiet!

Step 1: Drill hole, insert outdoor unit



Step 2: “Snap” on indoor unit



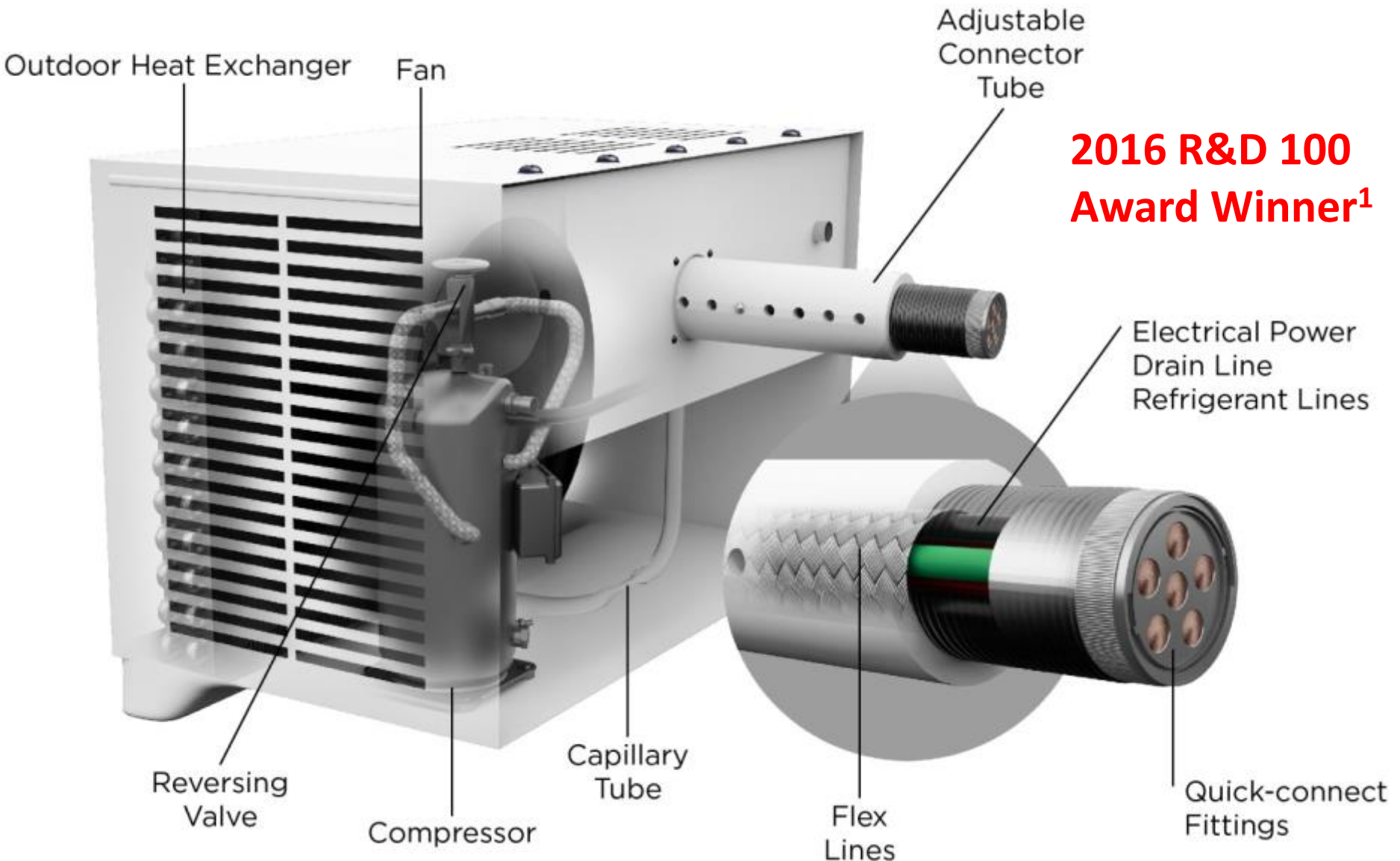
Numerous benefits:

- Increased energy efficiency
- Dramatic noise reduction
- Improved security and egress
- Installs on any exterior wall
- No need for seasonal storage
- DIY, tool-less installation
- Adapts to any wall thickness

Impacts

- Environmental
 - Save 0.2 Quad/year with estimated market penetration
 - 30-50% GWP reduction compared to mini-split heat pumps
- Societal
 - Initial product addresses needs of economically disadvantaged people
 - 33% of households below the poverty line use room air conditioners

Patent-Pending Connection System - Outside



¹ <http://www.rd100conference.com/awards/winners-finalists/6131/ecosnap-ac-heat-pump-system/>

5-10 Minute Installation



Value Proposition

Relative to Window and Portable ACs

- ~20% more efficient, saves \$21/year on average
- Simple payback of 2.5 years at \$50 price premium
- Potential to use in HOA communities for additions or cold/hot rooms in house
- Reduces water damage around windows
- No drilling holes in window frames for mounting/security

Relative to Mini-Split Heat Pumps

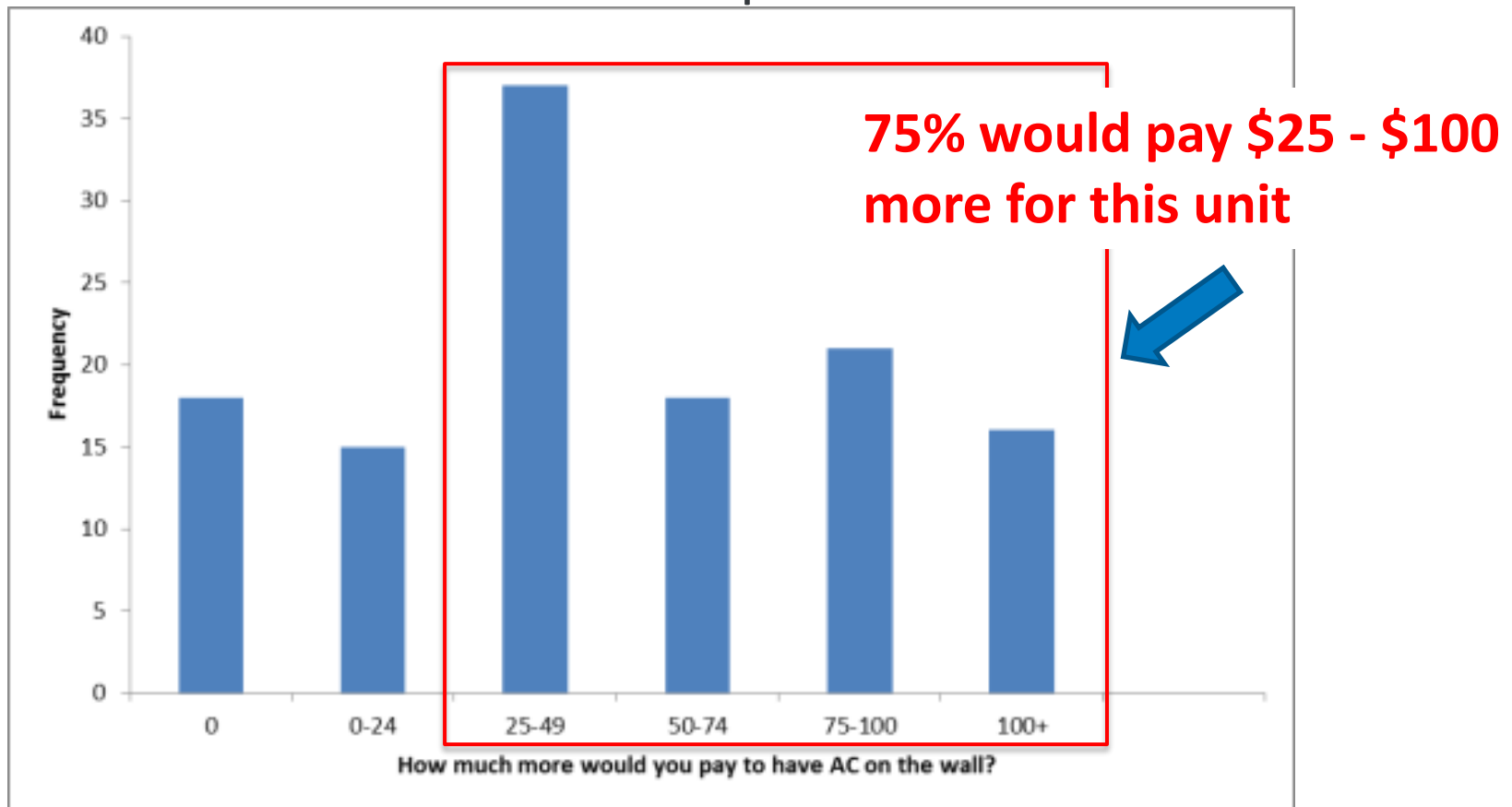
- Up to \$400 less on indoor and outdoor units for comparable efficiency
- No line-sets, ~\$150-\$250 savings
- No professional installation, \$2500-\$3000 savings
- No permits ~\$100-300 savings
- “Clean” exterior aesthetics – no lines running along house (electrical, line-set or condensate)

Competitive Analysis

	Window AC	Portable AC	Mini-Split	EcoSnap-AC
Keep window	✗	—	✓	✓
House security	✗	✓	✓	✓
Quiet	✗	✗	✓	✓
Attractive	✗	✗	✓	✓
Affordable	✓	✓	✗	✓
DIY	✓	✓	✗	✓
Permanent	✗	✗	✓	✓
Easy to Install	✓	✓	✗	✓
Efficient	✗	✗	✓	✓
Heats and Cools	✗	✗	✓	✓
Out of the way	✗	✗	✓	✓
Flexible location	✗	—	✓	✓
Seals out weather	✗	✓	✓	✓
Low-GWP	✓	✓	✗	✓

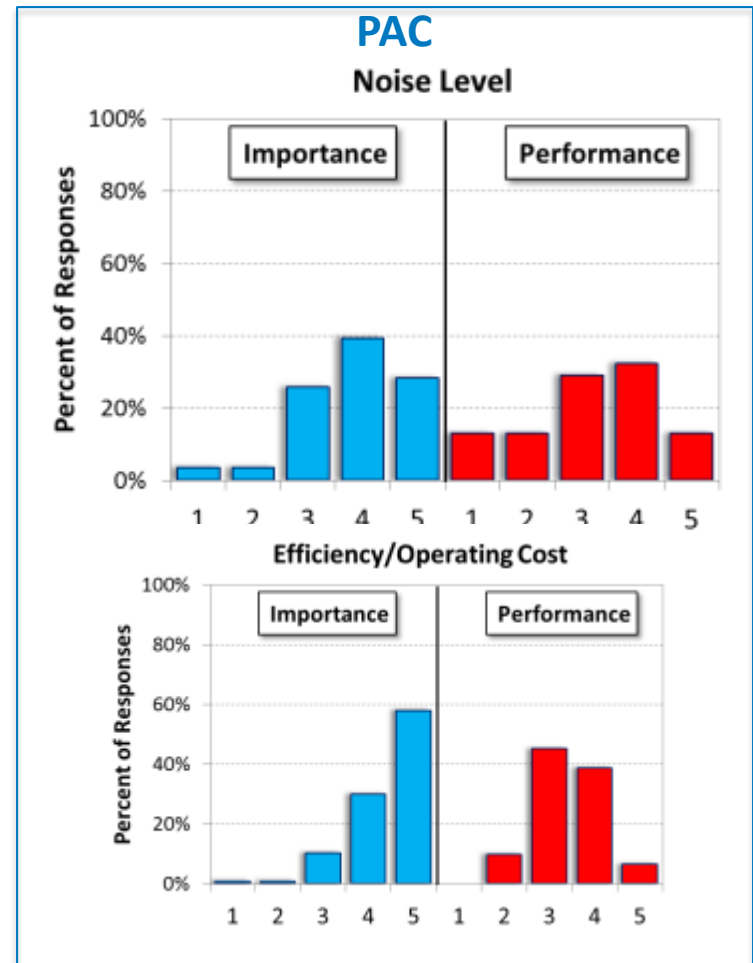
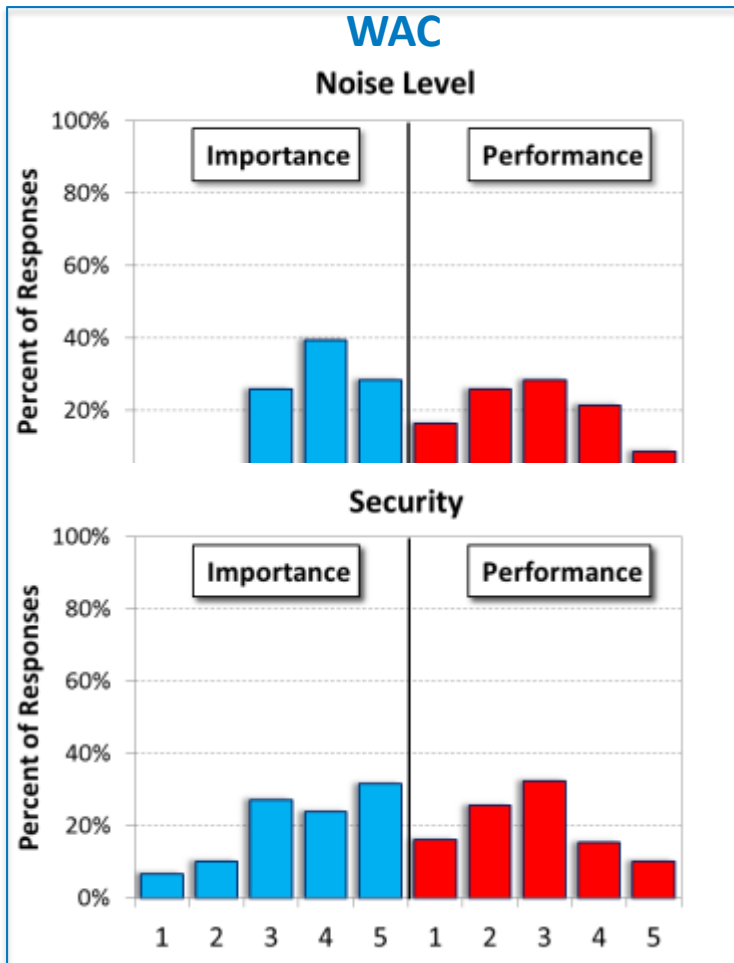
Consumer Research

- 440 survey respondents
- 43% with WAC or portable said they would be willing to drill 2" hole in the wall to put AC in it



Consumer Research

- People are generally happy with the cooling they get from WAC and PAC
- Security, noise, efficiency and aesthetics are opportunities



Met at the corporate headquarters for a major retailer. Head merchant for AC products said:

**“I have asked manufacturers for this exact thing
and they won’t make it”**

- Existing brands/manufacturers are complacent
 - Compete on hardware price, not on innovation
 - Opportunity to reduce installed cost to consumer through faster install
- Modest innovations can have a large impact

EcoSnap-AC Press

NREL Award Nominations:



National Lab Impact Summit

Lab-Corps Highlight: Cooling with a Snap

Dr. Chuck Booten and Dr. Jon Winkler from the National Renewable Energy Laboratory (NREL) decided to participate in Lab-Corps to explore the potential of their concept for an eco-friendly air conditioner. They called it Ecosnap-AC, inspired by the "snap" connection made between the evaporator and condenser parts of their product during installation. The duo knew that connecting through a wall rather than being window-mounted could solve a number of core problems with window cooling units, such as poor sealing and the obstruction of a window. It sounded like a great idea—but was there an



Dr. Jon Winkler (left) and Dr. Chuck Booten (right) install an Eco-Snap AC unit, which they prototyped during Lab-Corps Cohort I. The wall-mounted AC unit can be installed by a single person and performs up to 20 percent more efficiently than traditional window AC units. Photo Credit: Dennis Schroeder/NREL.



https://energy.gov/sites/prod/files/2016/05/f31/DOE_EERE_Lab%20Impact%20Summit_Packet_FINAL%20FOR%20PRINTING%204-27-16-wdoe-JF-web150.pdf

<http://www.nrel.gov/news/features/2016/33699>

DOE: Amped Up!



<https://energy.gov/eere/ampedup/articles/new-easy-install-air-conditioning-unit-frees-window-space-snap>

Contact Information

Chuck Booten, Ph.D.

Senior Engineer, Residential Building Systems
Mechanical and Thermal Systems Engineering
National Renewable Energy Laboratory

chuck.booten@nrel.gov

Presentation Highlights: National Renewable Energy Laboratory (NREL)

- **Key features of EcoSnap-AC:**
 - Installed on the exterior wall rather than blocking window
 - Split system
 - Eliminates air leakage and water infiltration
- **More affordable for people who need AC units most:** lower price than a mini-split heat pump, 20% more energy savings and higher rate of payback compared to a window unit.
 - Retail price for EcoSnap-AC is \$50–\$100 more per unit than the average window unit.
- **Do-it-yourself approach:** unlike other AC units that require professional installation, EcoSnap-AC can be installed in 15 minutes by customers.
- **Reduced noise and improved home security** (no line sets required)
- Expected to enter production in 2019/2020

Best Practices: Lawrence Berkeley National Laboratory

Cool Roof Time Machine

Ronnen Levinson, Ph.D.

Staff Scientist and Leader
Heat Island Group
Lawrence Berkeley National Laboratory

Innovation Station:
The Latest Advances in Energy Efficiency Technology

DOE Webinar • 2017-05-18



soiled white roof



albedo ≈ 0.5



+15 °C
[+27 °F]

How cool can open cool roofs be?



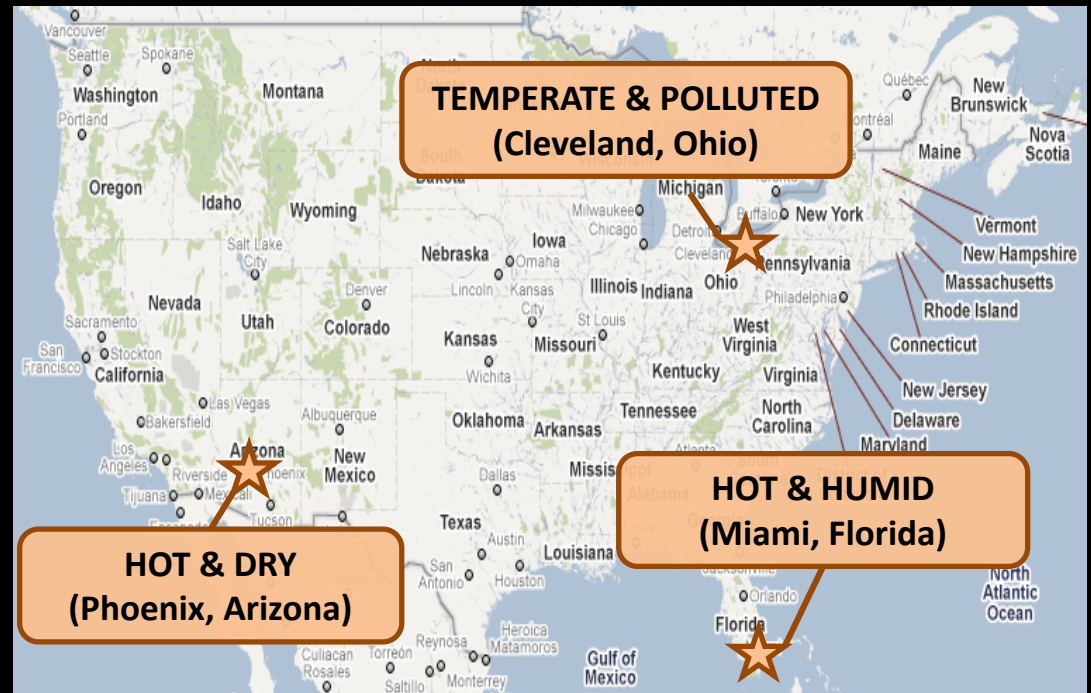
exposure rack

AZ
FL
OH

3 sites



3 years!



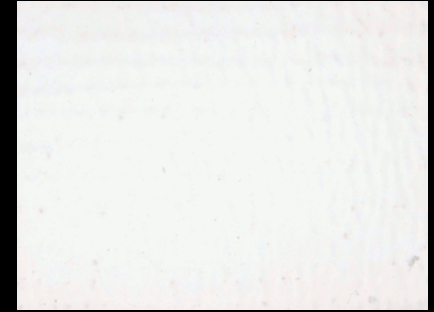
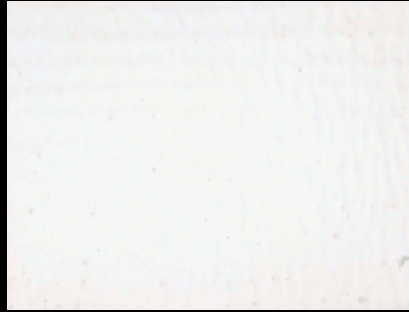
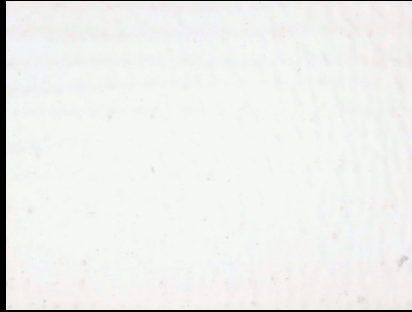
Arizona

Florida

Ohio

WHITE
COATING

(field-applied silicone)

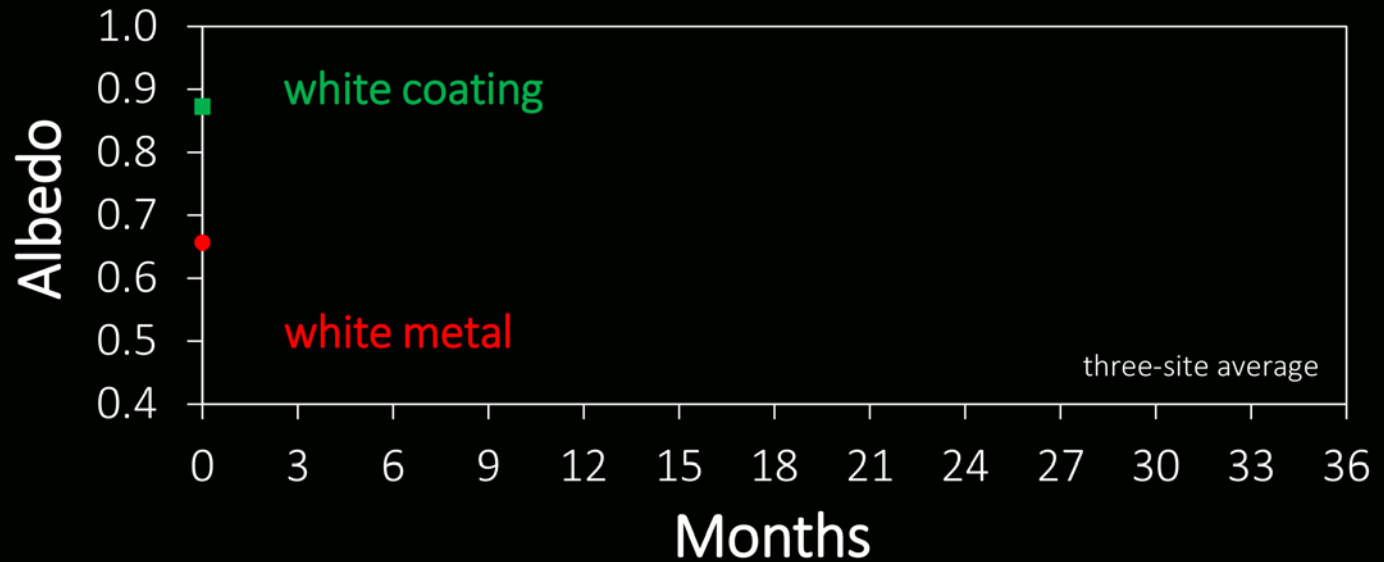


WHITE
METAL

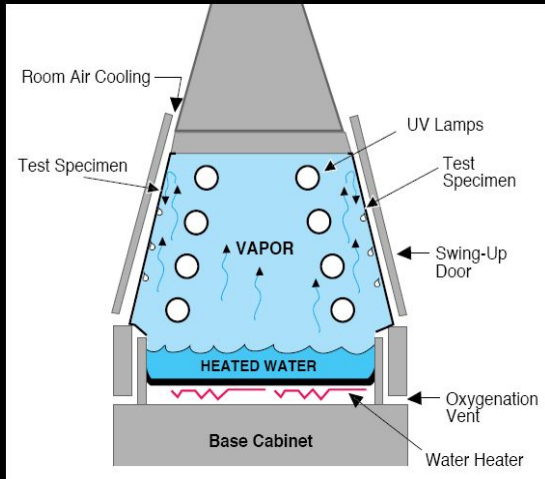
(factory-applied PVDF)



00
MONTHS



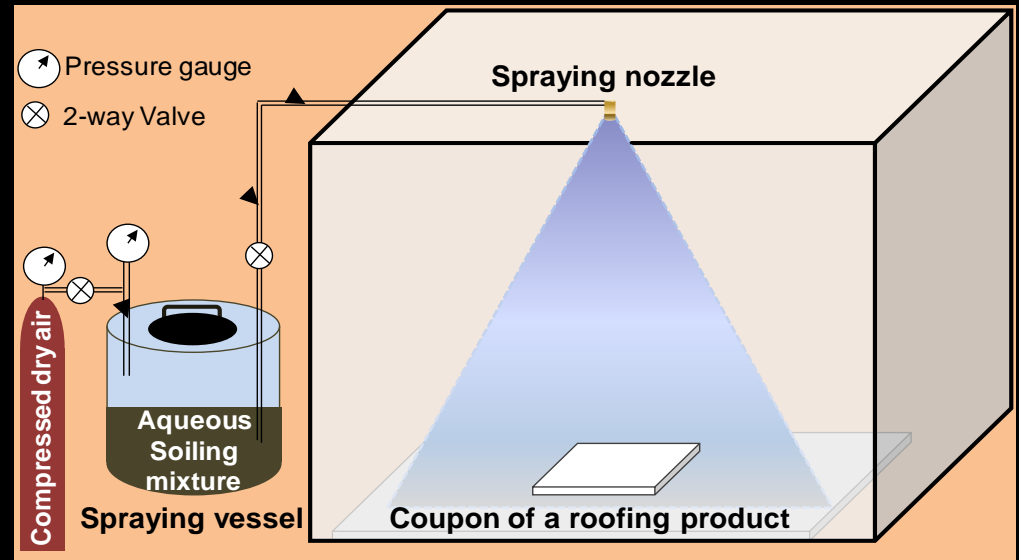
STEP 1: conditioning (24 hours)



STEP 3: weathering (24 hours)

Done!

STEP 2: soiling (10 minutes)



salts



dust



organics



soot

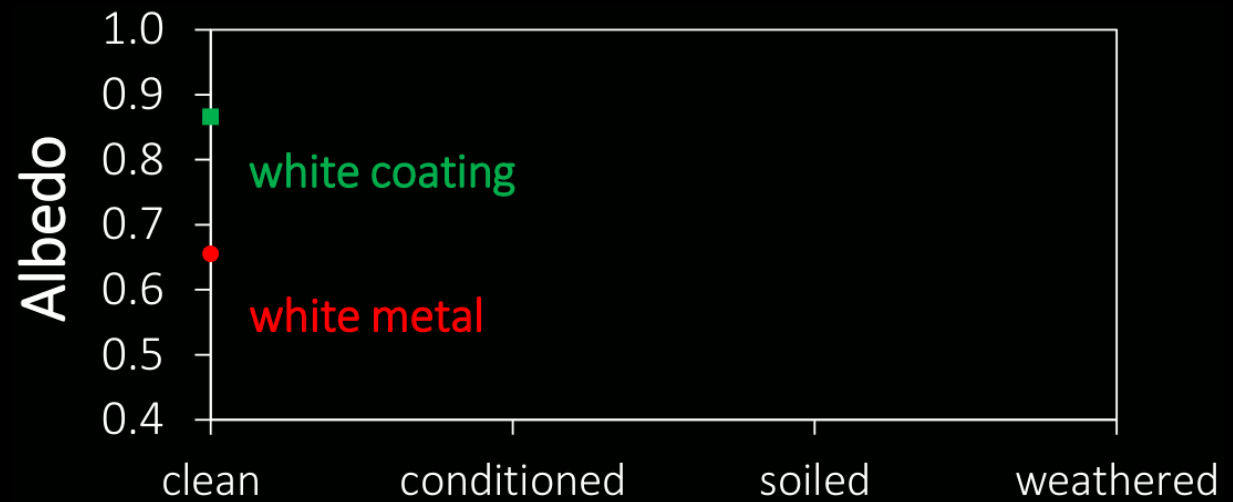
clean

WHITE COATING

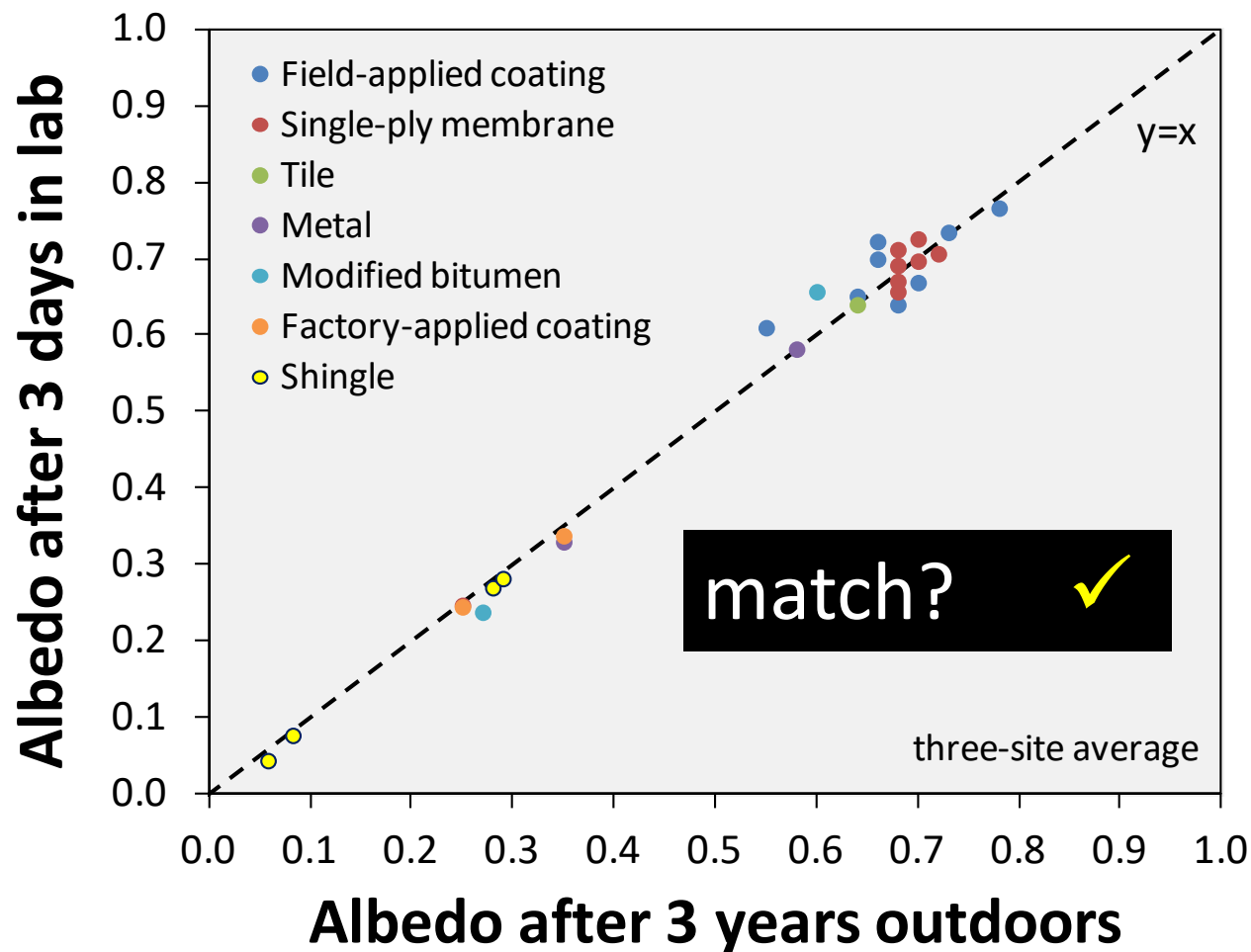
WHITE METAL



00:00
HR MIN



LBNL laboratory aging method quickly predicts 3-year-aged roof albedo, thermal emittance



- ASTM Standard D7897-15
- CRRC Rapid Ratings
- California Title 24

Sleiman et al. 2014. *SOLMAT* 122, 271–281
<http://dx.doi.org/10.1016/j.solmat.2013.11.028>

Presentation Highlights: Lawrence Berkeley National Laboratory (LBNL) (1 of 2)

- **LBNL's accelerated soiling and weathering method decreases the roof development and testing timeline from 3 years (current standard practice) to 3 days**
 - The method allows researchers to study the effectiveness of reflective materials in cool roofs over time and in different climates by mimicking environments and wear in a laboratory setting
- **Primary benefits of this method for the cool roofing industry include:**
 - faster prototyping of high-performance cool roofing materials
 - bringing new energy-efficient products to market nearly three years faster
 - providing an interim product rating to enable manufacturers to comply with energy codes like California Title 24
- **Winter penalties related to cool roofs are limited compared to summer savings**
 - Solar light during winter is low anyway, which makes heat loss limited

Presentation Highlights: Lawrence Berkeley National Laboratory (LBNL) (2 of 2)

- **Cool roofs and their interaction with solar PV:**
 - Oversizing the solar PV will not be as efficient as expected
 - Starting with cool roofs and then adding an integrated PV system could be a better option, especially in areas with hot climates
- **Some of the most performant and reflective materials on the market are clay tile, concrete tile or metal:**
 - Even for a cool dark colored surface, these can have a solar reflectance of up to 40%
 - Concrete tile slowly heats up during the day and cools down at night, which might reduce the need for air conditioning during summer and for heating in the winter
 - A roof assembly of this type will permit air flow between the roofing product and the roof deck
- **80% of homes in the U.S. have asphalt shingle, the least expensive roofing material**
 - Currently cool roof options for asphalt shingles are limited, but LBNL might look into those in the future

Best Practices: Acadia Center



**Acadia
Center**

Using Residential Load Control To Reduce Peak Load and Integrate Renewables

May 18, 2017

Jamie Howland, Director, Energy Efficiency and Demand
Side Initiative

Overview

- Examine the potential of intra-day load shifting to reduce loads on the grid
- Explore policy considerations associated with using energy efficiency programs to deploy Active Load Management (ALM)
- Provide recommendations for policy makers and efficiency program administrators.

Background

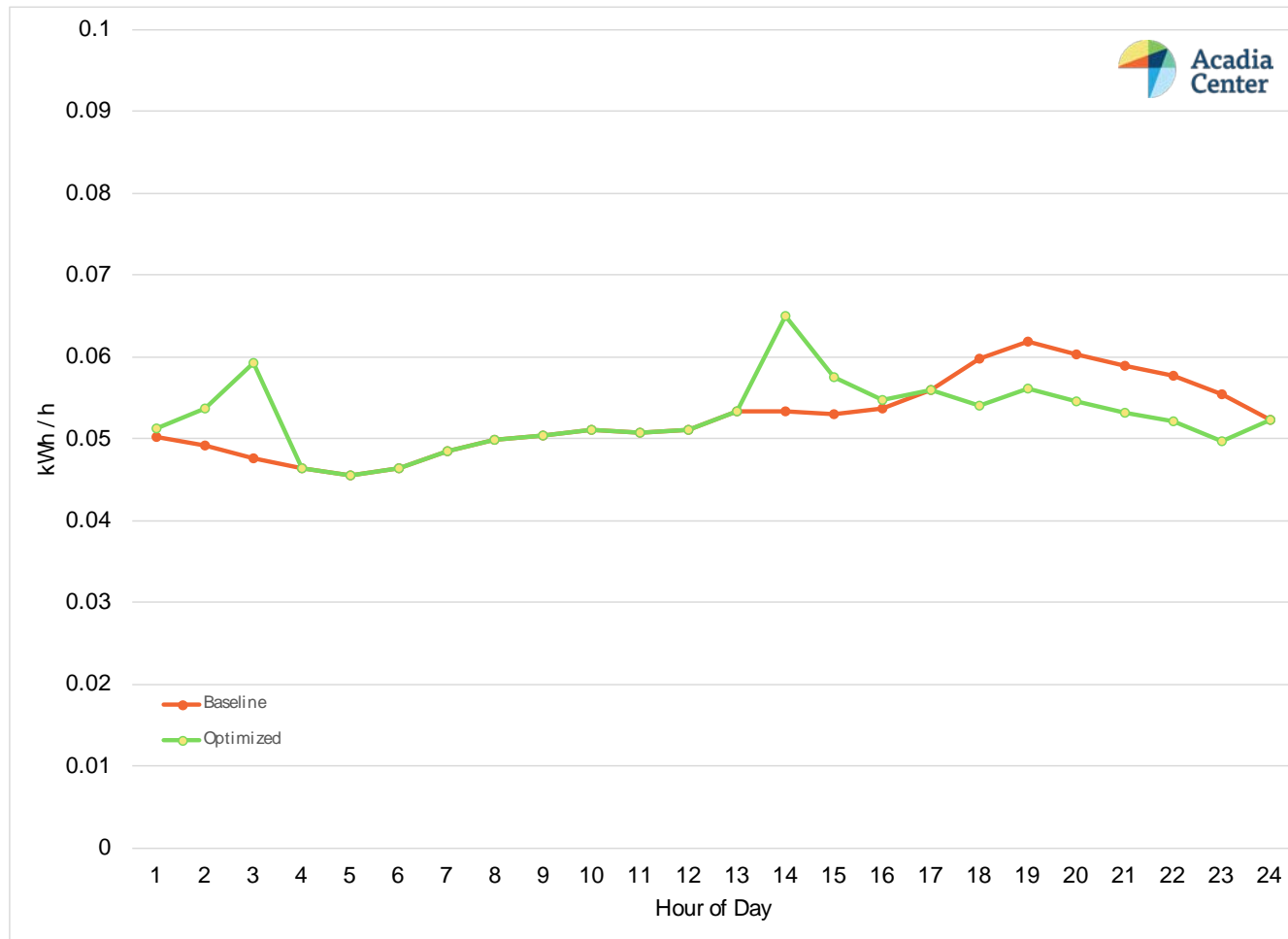
- The grid is changing!
 - Efficiency programs have led to declining energy use and flattened peak demand
 - Lots of PV in ISO-New England, and much more on the way
 - Electric Vehicles
 - Heat Pumps
- New and emerging technologies have lowered the cost of equipment controls, increasing the potential to harness the power of many small things

Definition of ALM

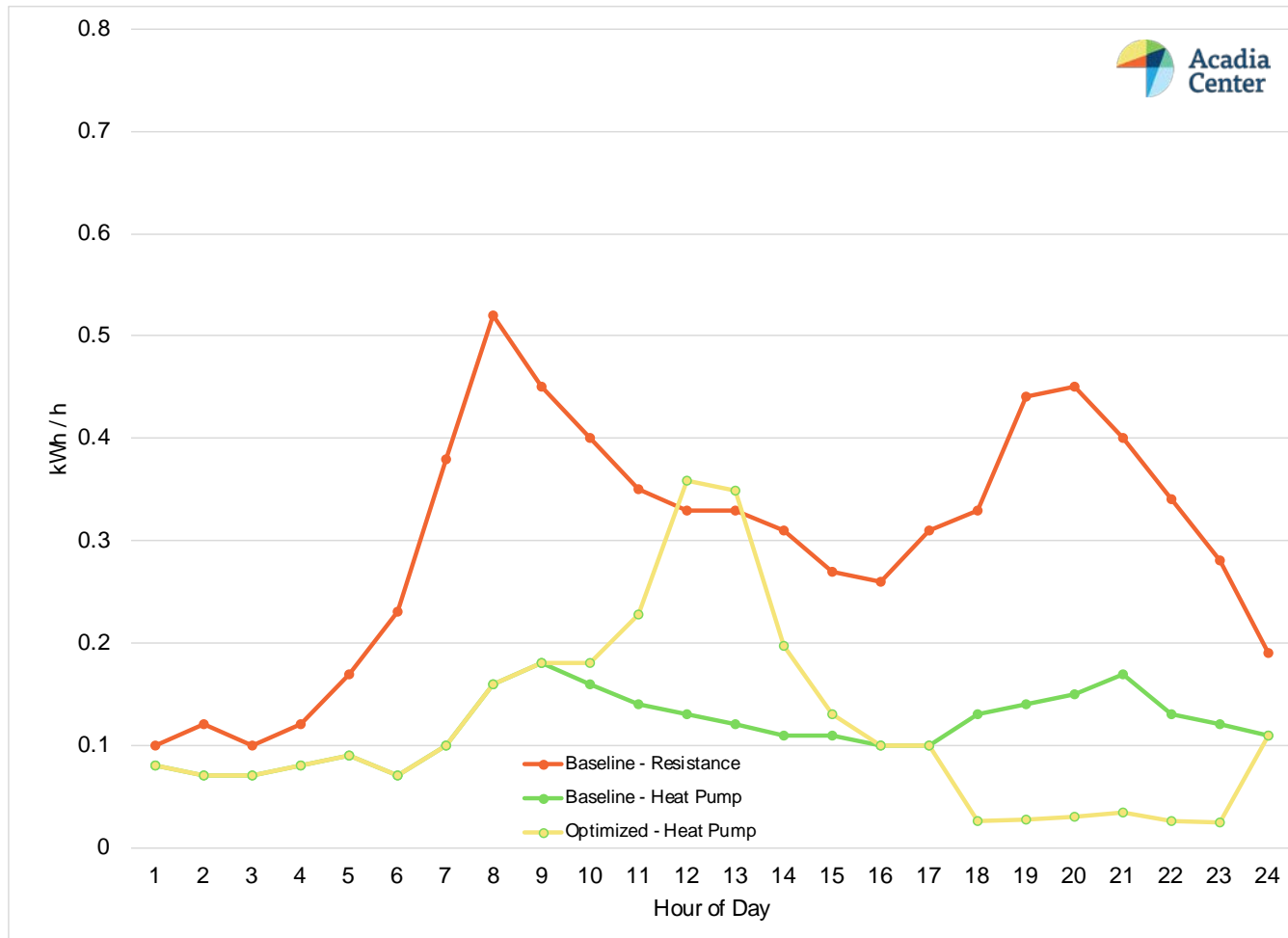
- There are several terms that refer to Load Management – generally moving load to a different time period.
- In this context, we use the term Demand Response (DR) to refer to traditional load management – curtailment of load by large customers when called upon to do so, typically with low frequency
- Active Load Management is defined here as including much smaller loads, varying times, more frequent dispatch, and more automated dispatch.

Analysis of Potential

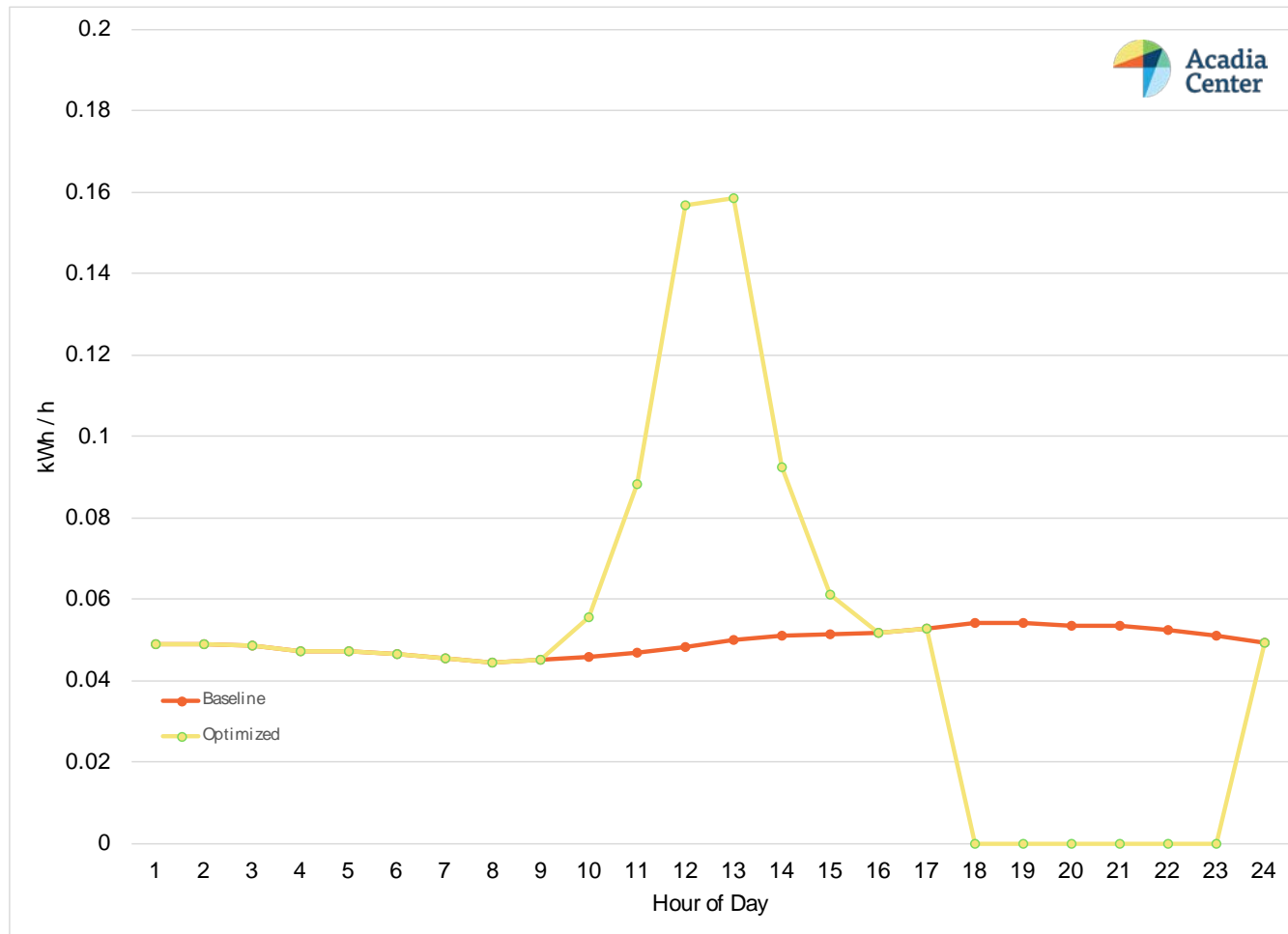
Refrigerators



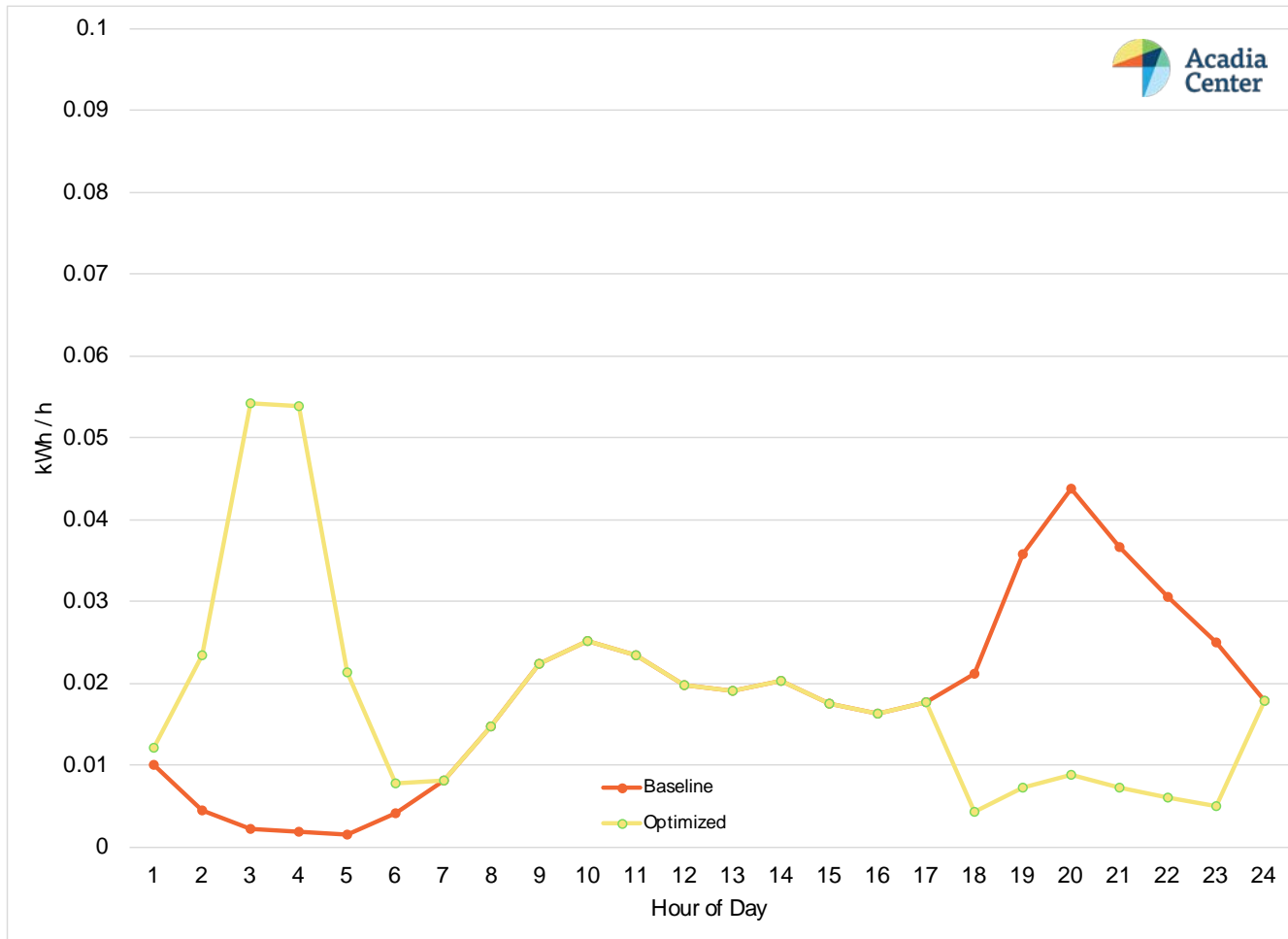
Hot Water Heaters



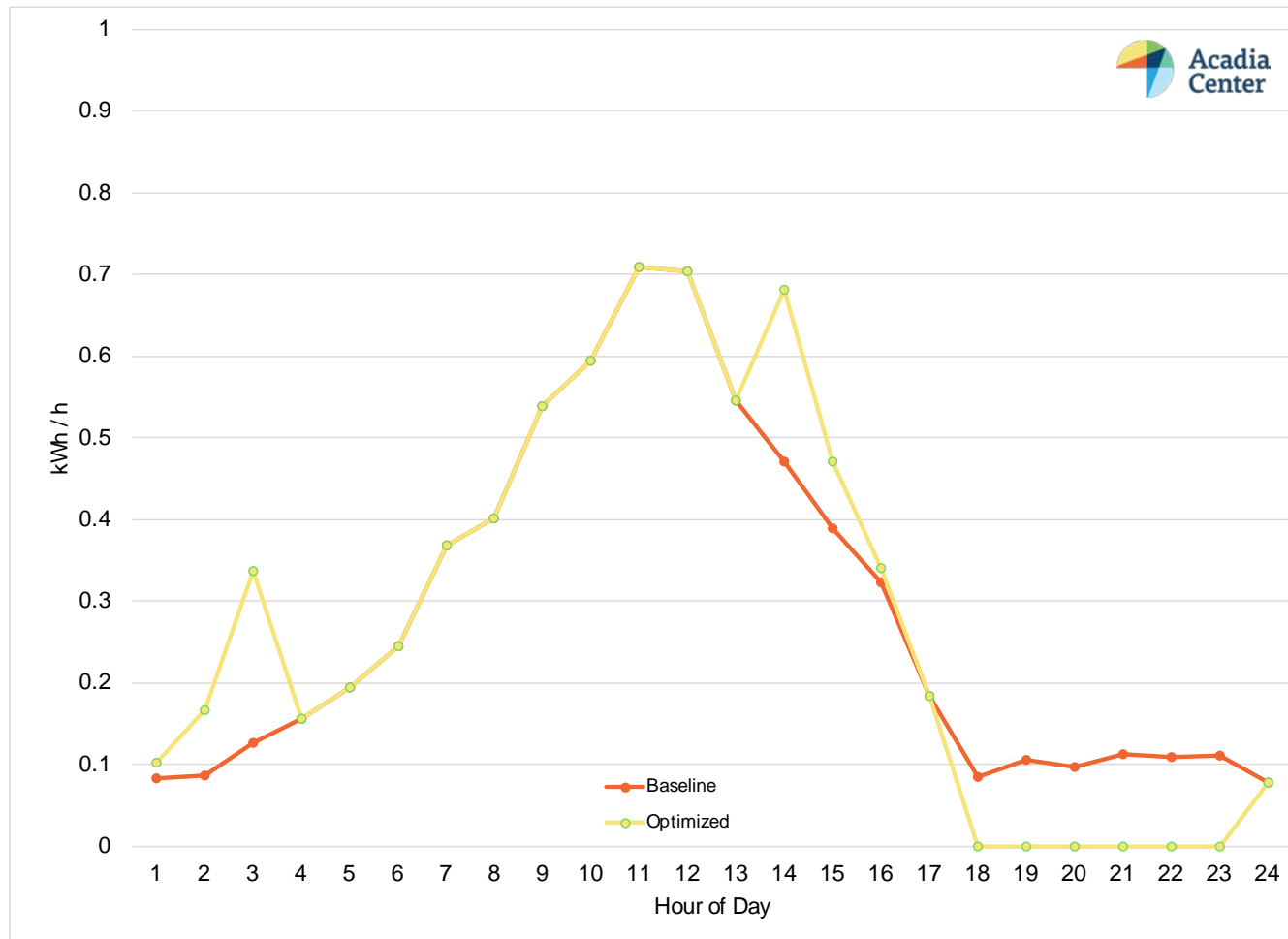
Freezers



Dishwashers

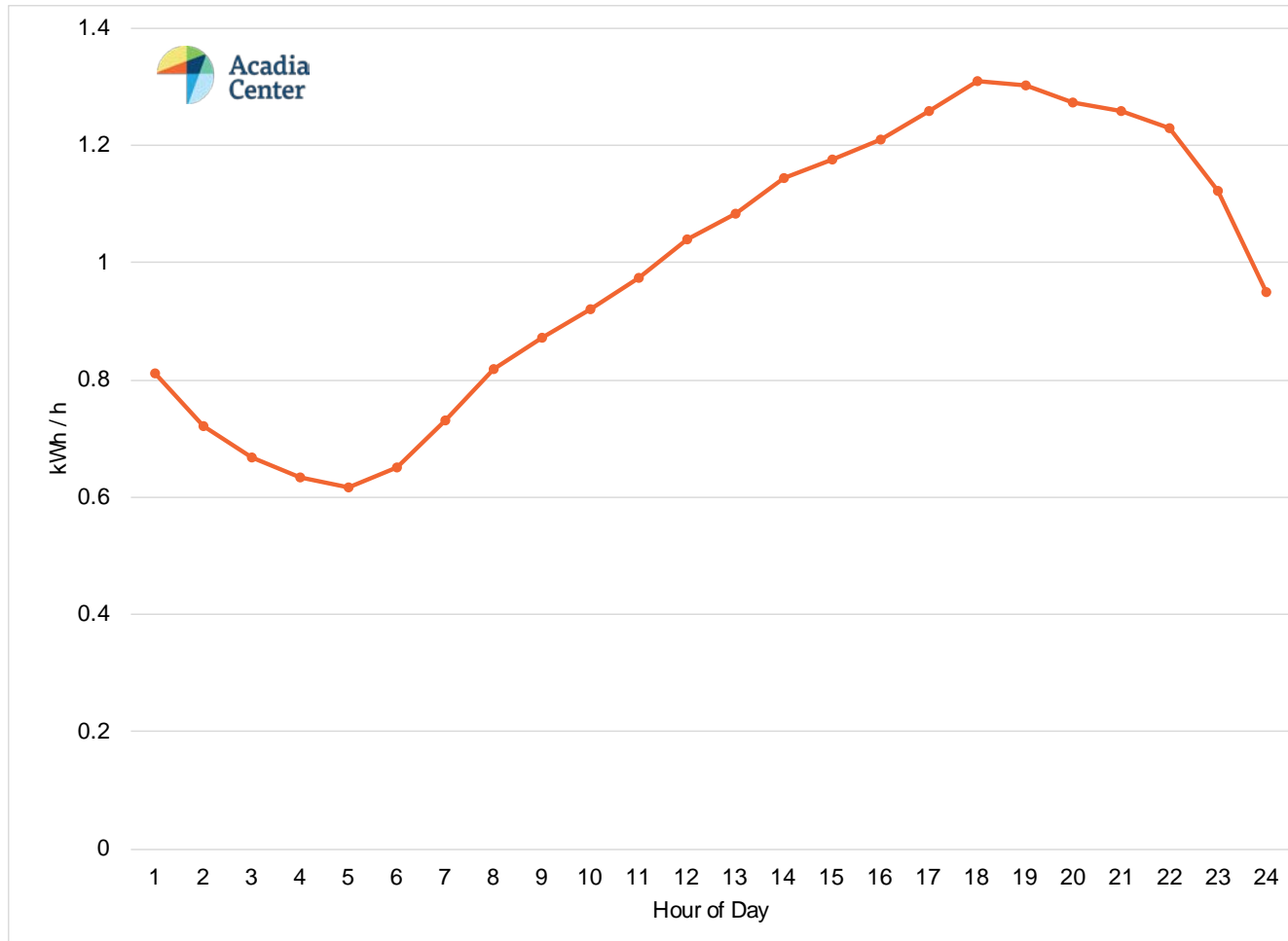


Pool Pumps

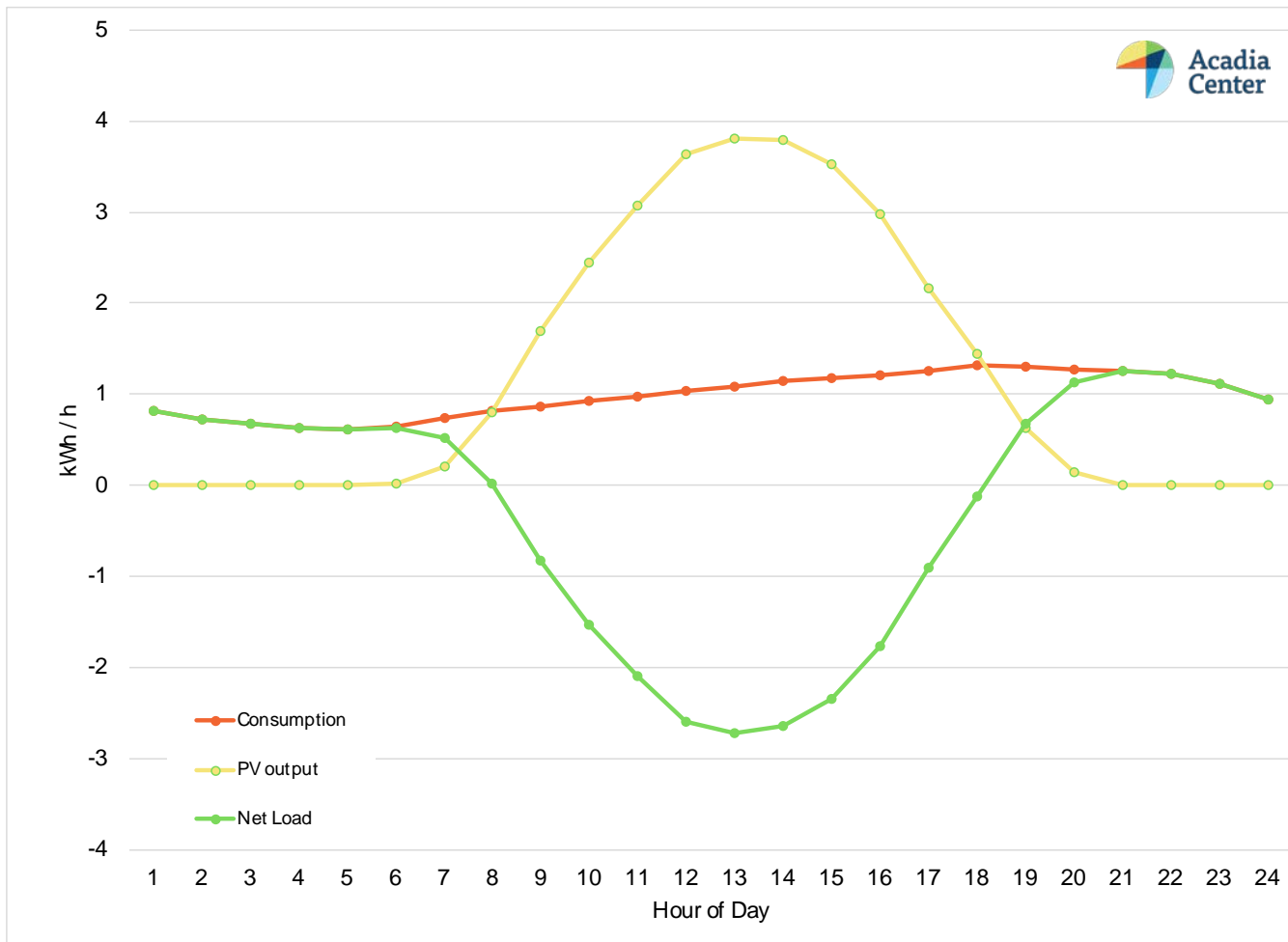


Results

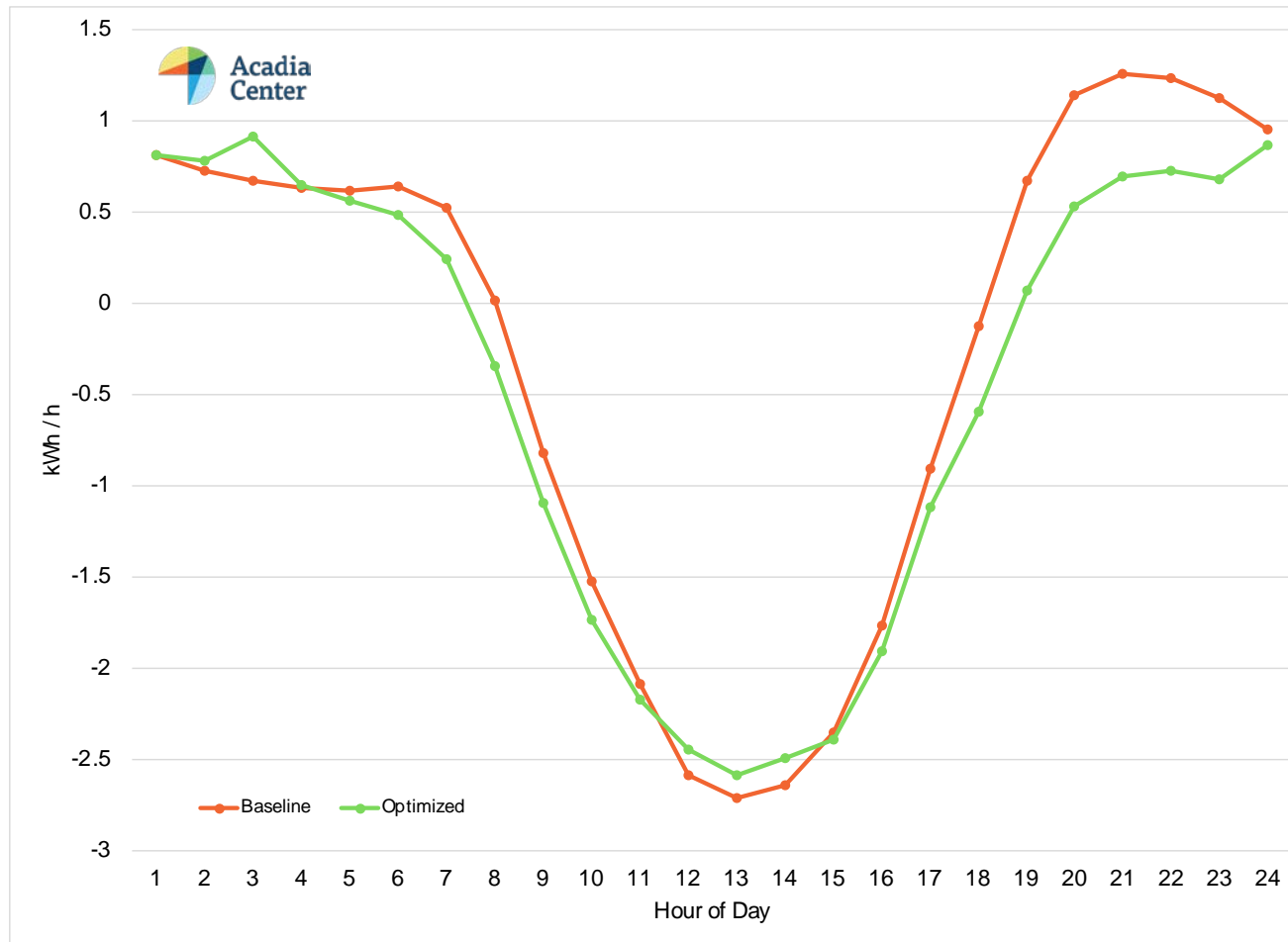
Load Profile for Average Home



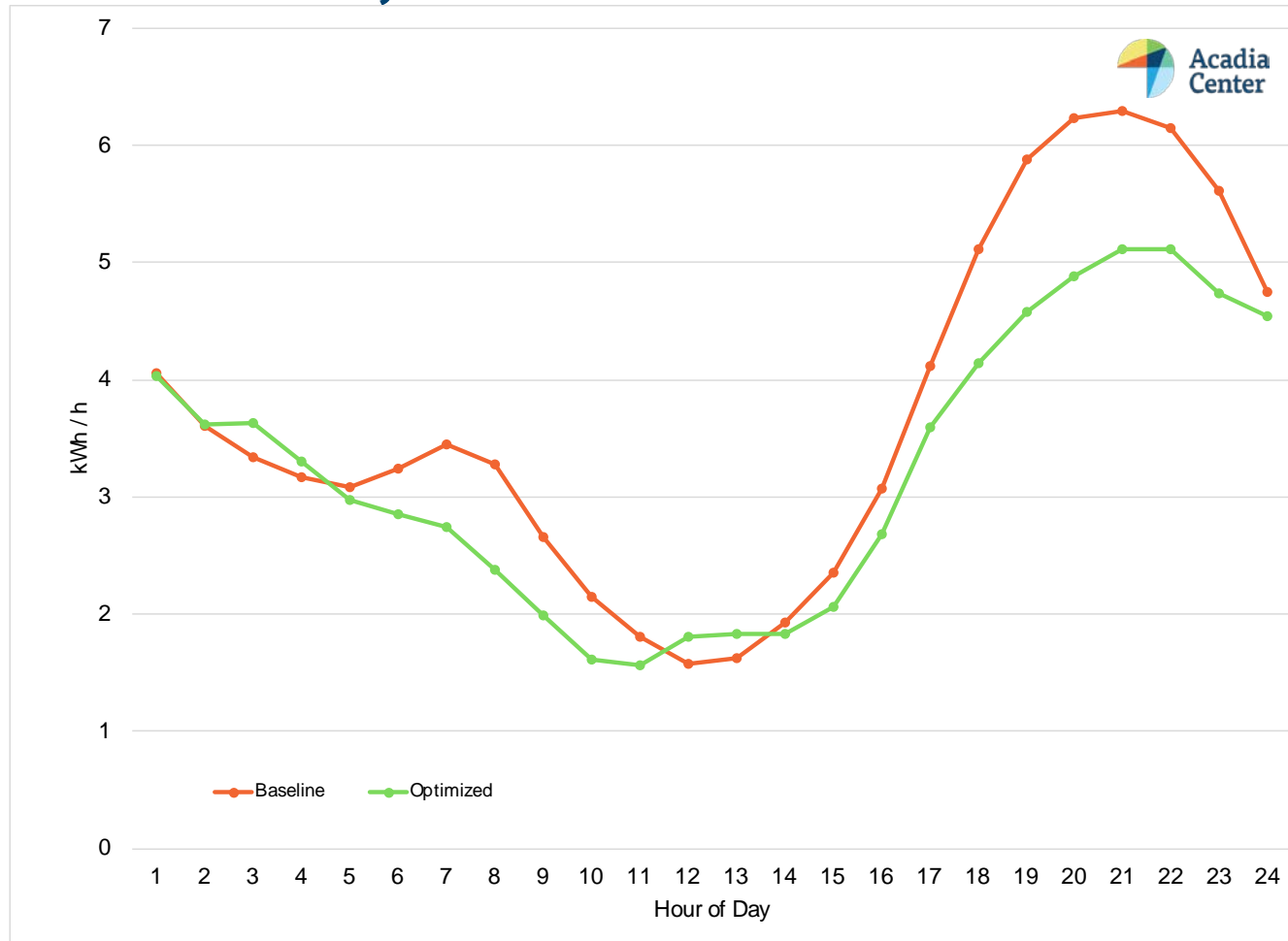
Load Profile for a Single Home with Solar PV



Combined Impact of Optimizing Use of All Five Products – Single Home w/ALM



Combined Impact – Five Homes with ALM; one with Solar PV



Creating a Policy Framework

Delivery Mechanism

- There are many possibilities for getting ALM products to customers and connecting them in a way that can respond to grid needs.
- **Transaction costs for the products included in this study need to be low for the economics to work.**
- All of the products included in this study are part of some energy efficiency programs around the country.

Compensating Participants

- Need to first consider revenue sources:
 - Energy and capacity markets
 - Value of avoided generation infrastructure and/or fuel
 - Value to the grid (both T&D) as a non-wires alternative
- Range of compensation options:
 - Paid full value of participation by a program administrator
 - Amount paid determined by market, similar to how EE rebates are set
 - Condition of an EE product rebate

Aggregator

- **Utility or third-party efficiency program administrator** seems like the most obvious choice for the role
 - Combines role of both delivering products and providing the compensation to customers
 - Existing relationship with customers
- Other options that could be considered include:
 - **For-profit third party;**
 - **Non-profit third-party** – e.g. a “Sustainable Energy Utility” tasked with providing non-infrastructure solutions; and,
 - **No aggregator** – customers instead respond to more granular rate structures.

Recommendations

- ALM can play a role in integrating renewables and optimizing the use of grid infrastructure.
- More work is needed to better understand value of peak load reductions to generation, transmission, and distribution costs.
- **Avoid lost opportunities.** We should no longer be incentivizing products that are not ALM capable when communicating / controllable versions are available at reasonable cost.
- Just like many small EE purchasing decisions have dramatically changed energy consumption, many small load shifting activities have the potential to lower grid costs.

Contact Information

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**Acadia
Center**

Boston, MA • Hartford, CT • New York, NY • Providence, RI •
Rockport, ME • Ottawa, ON, Canada

www.acadiacenter.org



www.acadiacenter.org

Presentation Highlights: Acadia Center

- **Load management can help avoid the need for new grid infrastructure** with more efficient use of the existing grid.
- Acadia's ALM analysis focused on the load shifting potential of 5 low-impact home appliances:
 - Low impact products included refrigerators, water heaters, freezers, dishwashers, and pool pumps, which tend to be less obtrusive for customers and easier to automate
 - Deferred appliance operation cycles (e.g. defrost time for refrigerators, start time for dishwashers) outside peak times
 - Stored energy during the day when solar production is high (e.g. in the case of hot water heaters)
- **Aggregated load shifting is critical.** A single home can produce about a half kilowatt reduction in load; impact is limited. **Demand response programs currently target large commercial customers** that can make significant load reductions.
- **Encouraging uptake of ALM products:**
 - Low cost for grid-connected home appliances
 - Compensate program participants either through fiscal incentives or product rebates
 - Energy programs should incentivize the use of connectable devices, which could pave the way for more ALM programs in the future

Discussion Highlights

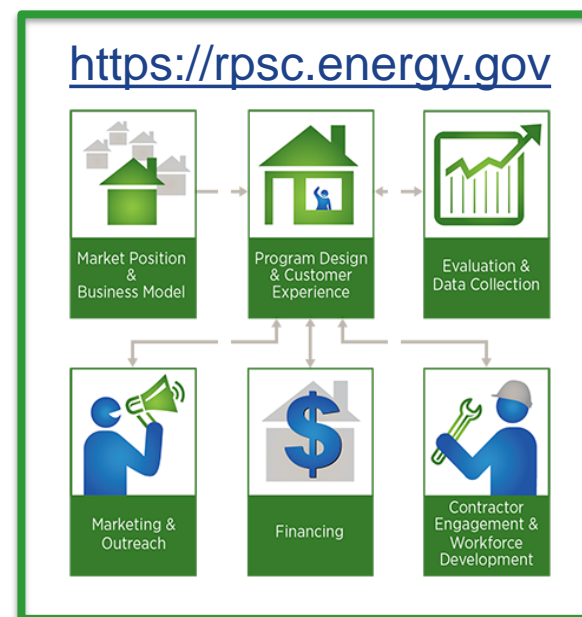
Consumers Energy, a public utility in Michigan, has a peak demand saving program for all the electric customers, piloted by Clear Result:

- By the end of 2017, all of their customers will have new updated digital read meters.
- Customers that enroll in this program are given a credit on their bill for making energy-efficient adjustments.
- Two initiatives are developed under this program:
 - **AC Peak Cycling:** a small device is installed on the AC, which will make the unit to run for short periods during “cycling events” (no more than 4 hours) and then go back to the customer’s initial settings.
 - **Time of Use:** a “stick and carrots” program based on incentives where customers need to actively participate to savings (e.g. turning the AC off when they’re not home).
 - If customers stay under a set amount of electricity usage, they are credited based on the kWh saved.

Related Resources in the Residential Program Solution Center

Explore resources related to the latest advances in energy efficiency technology:

- Find out how emerging technologies including advanced data collection (e.g. AMI, smart meters) and data analytics tools are changing the EM&V landscape, in this [NEEP report](#).
- Read an overview of existing and future residential use cases for connected thermostats in this [DOE report](#).
- Explore this [ACEEE report](#) analyzing the adoption and applications of intelligent energy efficiency technologies across multiple sectors of the economy.



- Check out the latest [Proven Practices](#) post on [Offering a Range of Upgrade Paths](#).
- The Solution Center is continually updated to support residential energy efficiency programs—[member ideas are wanted](#)!

Join the roofing systems innovation challenge

Join the roofing systems innovation challenge!

Register for the webinar: June 29, 2-3pm ET

Oak Ridge National Lab has partnered with [GAF](#) to host a technology challenge on roofing systems. The *call for innovation* is part of the online crowdsourcing site, [JUMP](#), and aims to identify innovation solutions for ensuring energy efficient and durable low-slope roofing systems employing concrete decks.

The [challenge](#) is to develop new materials or installation methods that can be employed to modify a typical roofing system with a concrete deck so that the likelihood of having moisture related problems is significantly reduced. **The winner would receive \$10K in cash sponsored by GAF and up to \$20K in-kind support from ORNL technical scientist.**

Register for the challenge [webinar](#) on June 29 from 2-3pm ET to learn more. Ideas will be accepted through Sunday, August 27, 2017.

Peer Exchange Call Series

We hold one Peer Exchange call the first four Thursdays of each month from 1:00-2:30 pm ET

Calls cover a range of topics, including financing & revenue, data & evaluation, business partners, multifamily housing, and marketing & outreach for all stages of program development and implementation

Upcoming calls:

- May 25 & June 1: No calls
- June 8: [Expanding Your Reach: Creating Sustainable Energy Communities](#)
- June 15: [Home Improvement Catalyst: HVAC Installations That Deliver](#)
- June 22: [Car Talk: Electric Vehicles and Residential Energy Efficiency](#)
- June 29: [Community-Based Social Marketing: Using Social Science and Data to Change Behavior](#)
- July 6: No call
- July 13: [Resilience and Energy Efficiency in Low-Income Communities](#)

Send call topic ideas to peerexchange@rossstrategic.com

See the Better Buildings Residential Network Program [website](#) to register

GET SOCIAL WITH US



Stay engaged and connected with the Better Buildings Residential Network and our partners from the residential and multifamily sectors!

Follow us to plug into the latest Better Buildings news and updates!

Share with us your top stories on how your organization is accelerating energy savings through efficiency upgrades, strategies, and investment!



[Better Buildings Twitter](#) with [#BBResNet](#)



[Better Buildings LinkedIn](#)

We can't wait to hear from you!

U.S. Department of Energy Solar Decathlon



Oct 5-15, 2017 DENVER

- 13 Collegiate teams compete in 10 contests
 - New for 2017: Innovation and Water
- Winning team best blends technology, market potential, design excellence with smart energy solar production and maximum energy and water efficiency.
- Large free public event – showcases best of clean energy technology
- Denver location: new, mixed use smart community on transit line near Denver International Airport
- Sponsorship Opportunities
- Info: www.SolarDecathlon.Gov



Solar Decathlon 2015 Teams in Irvine, Calif.

Credit: Thomas Kelsey/U.S. Department of Energy Solar Decathlon

Addenda: Attendee Information and Poll Results

Call Attendees: Network Members

- Center for Energy and Environment (CEE)
- Center for Sustainable Energy
- City of Cambridge
- City of Chula Vista
- Civic Works
- Clearesult
- Connecticut Green Bank
- Efficiency Maine
- Efficiency Nova Scotia
- Efficiency Vermont
- California Energy Commission
- Honeywell International, Inc.
- International Center for Appropriate and Sustainable Technology (ICAST)
- La Plata Electric Association
- Michigan Saves
- New York State Energy Research & Development Authority (NYSERDA)
- Texas Energy Poverty Research Institute

Call Attendees: Non-Members (1 of 3)

- Acadia Center
- AEMEP Group
- Arizona State University
- BC Housing
- Best Energy Inspections
- Brookside Construction
- Carolina Smart Homes
- City of Asheville
- Clallam County
- Clark County
- Codman Square
Neighborhood Development
Corporation
- Coolman Communities, Inc.
- County of San Diego
- California Public Utilities
Commission
- Connecticut Wildlife Action
Plan (WAP)
- Danfoss Group
- E4TheFuture
- Energy Information
Administration
- EPA Region 7 (Midwest)
- Evergreen Home
Performance

Call Attendees: Non-Members (2 of 3)

- Flathead Electric Cooperative
- FS Energy
- Geo-Enterprises, Inc.
- GoodCents
- Groundswell
- Generación y Certificación de Energía, SLU.
- HILCO Electric Cooperative Inc.
- Holy Cross Energy
- Hunsí Group Inc
- Huntington Bank
- I Custom
- Insightful Healthy Homes Inc.
- John K Holton
Architect/Engineer
- K-Electric
- King County (WA)
- Lake Apopka Natural Gas District
- Lawrence Berkeley National Laboratory
- LEENA Labs
- Local Government Commission
- Local Government Commission/Americorps

Call Attendees: Non-Members (3 of 3)

- Mercy Housing
- National Renewable Energy Laboratory (NREL)
- Northwest Energy Efficiency Alliance
- Power Integrations
- PV Blue
- Retrofit Baltimore
- Rheem
- Rhode Island Housing
- Robinson Sustainable Builders, LLC
- Scalable Strategies
- Sim2
- Snohomish County
- Solar Habitats, LLC
- Strategic Governance Group International
- Southwest Energy Efficiency Project (SWEET)
- Tennessee Valley Authority
- Texas A&M University - Kingsville
- The S/L/A/M Collaborative Inc.
- Therma-Stor LLC
- University of Minnesota
- Wheat Ridge Solar

Call Attendee Locations



Opening Poll #1

- Which of the following best describes your organization's experience with innovations in energy efficiency technology?
 - Some experience/familiarity – **41%**
 - Very experienced/familiar – **39%**
 - Limited experience/familiarity – **13%**
 - No experience/familiarity – **5%**
 - Not applicable – **2%**

Closing Poll

- After today's call, what will you do?
 - Seek out additional information on one or more of the ideas – **70%**
 - Consider implementing one or more of the ideas discussed – **13%**
 - Make no changes to your current approach – **13%**
 - Other (please explain) – **4%**